SP-E1 Model Development

October 25, 2002

1.0 Introduction/Background

The Federal Energy Regulatory Commission (FERC) relicensing process requires a great deal of analysis both operational and environmental. Much of this analysis is based on "what if" questions such as What if we kept Oroville Reservoir Elevation higher until Labor Day? Or "What if we build another power plant at Hyatt? The answers to these and many other similar questions cannot be found from analysis of existing data since the situations covered by the questions have never happened.

Computer models can produce estimates of the system response to changes in operations and or facilities that would results if the questions were actually implemented. These estimated operations can then be used to perform impact analysis to evaluate the operational, economic, or environmental impacts of the issue being addressed for FERC's relicensing process.

2.0 Study Objective

The objective of this study is to develop and validate the necessary models, including collection of supporting data to simulate the physical attributes of project operations to support studies involving changes to or impacts on flow, water levels, water supply, water temperature, and power generation. This study will not perform the actual simulations required for any analysis, it will simply provide the tools that are anticipated to be required to perform the actual analysis.

3.0 Relationship to Relicensing /Need for the Study

Computer simulations will be an integral part of many studies and analyses for the relicensing process. Additional computer studies will be part of other Work Groups' study plans addressing the myriad of stakeholder concerns and questions. The model development intends to ensure adequate computer modeling resources will be available to complete the needed studies. These studies will enhance information developed for FERC.

Adequate computer models to address the anticipated issues of concern in the relicensing process do not already exist. There are some existing models that may be useful as is or with some enhancement work and there are other models that will need to be developed from scratch. These models also need to be integrated so that the results of one model, for example an operations model, can be used in another model, for example a temperature model, to produce results that can be used in an analysis, for example a fishery analysis. This study is will produce the integrated set of modeling tools required to address the anticipated issues of concern.

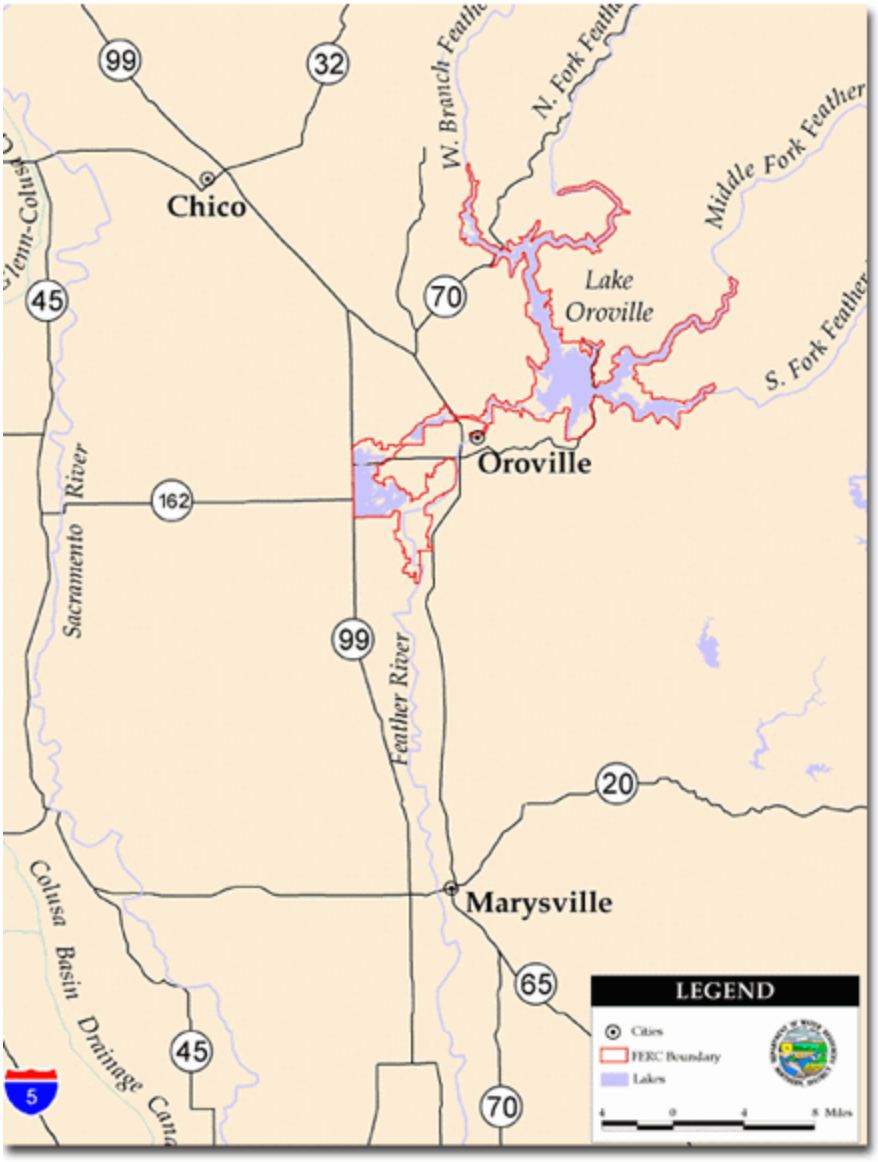
This study will address the following Issue Statements and associated specific Issues:

- E1—evaluate the potential for adding additional generation using existing infrastructure, modifying facilities to increase storage and associated generation, and changing operation to provide spinning reserve (e.g., motoring) (Issues addressed: EE 1, 2, and 14).
- E4—evaluate environmental and economic aspects of different flow regimes of Project operations. Factors to be considered include timing, magnitude and duration of flows, pump-back scheduling and maintenance scheduling, and hatchery operations.
- E6—effect of ramping rates on downstream facilities, power generation, water supply, water temperatures, and fish.
- E7—Effect of the project including discharge (magnitude, frequency and timing) and ramping rates and the altered stream hydrology on substrate scour, mobilization of sediments, turbidity levels, and riparian vegetation in the low flow reach and downstream of the Afterbay.
- E10—Effect of future water demands on project operations including power generation, lake levels and downstream flows. Consider sale of existing water allotments to downstream users.
- E12—Evaluate operational and engineering alternatives including selective withdrawal from Lake Oroville, Thermalito Afterbay, the hatchery, and the low flow section to meet various downstream temperature requirements.
- E14—Evaluate operational alternatives that balance and maintain acceptable water quality standards including those for MTBE under all operational plans and conditions.
- E15—Evaluate operation alternatives that maintain or improve current water supply under all operation plans and conditions.

4.0 Study Area

The Study Area includes the major facilities of the United States Bureau of Reclamation's (USBR's) Central Valley Project (CVP) and the California Department of Water Resources' (DWR's) State Water Project (SWP). These include the Trinity, Sacramento, and San Joaquin River Basins as well as the Sacramento-San Joaquin Delta and the Delta Mendota Canal and California Aqueduct canal systems. Geographic scope may be refined as additional information is developed and needs are identified through collaboration with other Work Groups. The major work is expected to focus on the Oroville-Thermalito Complex and the Feather River downstream to the confluence with the Yuba River.


Select from the following
Map Views
Major Rivers
State Projects
Federal Projects
Local Projects
All Water Projects
Redding
Sacramento
San
Francisco
Fresno
Los
Angeles
San
Diego



5.0 General Approach

This study plan is fairly general in approach because of the lack of firm requirements for modeling results from other work groups at this time. As the other work groups complete their study plans the requirements for modeling results will become better defined. This will be taken into account in the development of the individual modeling tools by modifying the individual model development plans as required.

This approach has been taken because analysis that will rely on computer simulation results cannot begin until the models are fully developed and the actual modeling simulations required are completed. If model development does not begin before the results are required the entire relicensing process could be delayed.

Because of this and because much of the model development work is general in nature this study plan can be written in more general terms than many other study plans. This approach will allow the model development efforts to begin sooner with the expectation that they will also be completed sooner than if we waited until all the requirements were known.

Detailed Methodology and Analysis Procedures

Task 1—Define Modeling Scheme

Based on past FERC relicensing procedures, literature review and discussions with other Work Groups, it is anticipated that at least the following tools may be needed:

- Statewide Operations Simulation Model (CALSIM II)
- Oroville-Thermalito Complex Local Operations Simulation Model
- Oroville-Thermalito Complex and Feather River Temperature Model(s)
- Feather River Stage Discharge Model
- Feather River Sediment Transport Model
- In-Stream Flow Methodology Model
- Watershed Model
- Flood Control Model

These tools will be used in a predefined modeling scheme to perform the full range of modeling required to produce the outputs required for the analysis (Attachment A). Not all of these tools will be developed or used by the Engineering and Operations Work Group but all must be taken into account to setup a modeling scheme that ensures consistency between the modeling efforts and the final analysis process. The modeling scheme will specify at a minimum:

- Major assumptions for modeling scheme
- Specific modeling tools that will be developed and used by the Engineering and Operations Work Group
- Data translation – transfer protocols between modeling tools, including modeling tools developed and used by other groups (Attachment B)
- Procedures and process required to perform a full modeling effort for an alternative including required iterations between models.
- Database procedures and tools required for the model integration

Task 1A—Major Assumptions for Modeling Scheme

This subtask will specify a number of major modeling assumptions that are required. These include:

- How will data be managed between the multiple models?
- What are appropriate assumptions for benchmark studies?
- What period of analysis for the process major possibilities include:
  - 1922-1994
  - Typical Years (Wet, Above Normal, Below Normal, Dry, Critical)
  - Typical Years with different starting storage in Oroville Reservoir

- Positional Analysis

Task 1B—Specific Modeling Tools

This subtask is the identification of the specific modeling tools to be used. This process is performed as a part of each individual model development plan but they need to be co-coordinated to ensure that data can be passed between the models.

Task 1C—Data Translation

This task includes the identification of the data that is taken from one model and passed to the next. The model representation of the system, the timestep, accuracy, and the details of what the specific input/output represents all need to be taken into account to ensure that the data is compatible between the two models. Specific translation utilities will be developed for each data translation identified in this process.

Task 1D—Modeling Procedures and Process

This task will define the modeling procedures that will be followed. Specific model simulations may be performed by different people at different physical locations. Specific issues addressed include:

- How will modeling requests from other study groups by coordinated?
- Who will be responsible for the completion of a full set of modeling for a request?
- How will we decided which models need to be run for a specific request?
- Who will perform the actual simulation with each model?
- How will the simulations be verified?
- Who will be responsible for integration of the specific model simulations into the overall modeling scheme?
- How will the simulation results be communicated between different physical locations?

Task 1E—Database Procedures and Tools Required for the Model Integration

This task will define and develop the actual central database and all procedures and/or tools required. The task will include development of a process to document all data items that are included in the central database.

Task 2—Define Individual Model Development Plans

The specific models currently anticipated to be developed and/or used by the Engineering and Operations Work Group are:

- Statewide Operations Model (CALSIM II)
- Oroville-Thermalito Complex Local Operations Model
- Oroville Reservoir Temperature Model
- Thermalito Forebay-Afterbay Temperature Model (Empirical Model)
- Feather River Temperature Model
- Feather River Flow—Stage Model

- Watershed Model (?)
- Flood Control Model (?)

Each of these models will be developed following a similar process that includes:

- Define outputs desired from the model and how they fit into the final analysis. This will require coordination with study plans from all other work groups that may use the results of the specific model in their analysis.
- Review existing models that could be used.
- Review existing data for model development/calibration/verification/production use suitability.
- Review modeling tools that could be used to develop new models.
- Select appropriate model or modeling tool.
- Collect field data needed for model calibration/verification.
- Complete model development/calibration/verification process.
- Integrate completed model into overall modeling scheme from Task 1.
- Perform benchmark simulations and integrate results into overall modeling scheme.

A custom plan will be developed for each individual model based on the unique needs of the particular modeling tool selected and required outputs form the modeling. The custom plans for the potential watershed and flood control model have not been developed at this time because of the lack of information on why the models are required. They are mentioned here in case they are needed when the final analysis data needs are defined.

Task 3—Develop Individual Models

Using the development plan for each individual model complete the actual development work including and collection of data, calibration, and verification.

Task—Fully Implement Modeling Scheme

This task will include development of all databases, data translation, and data transfer tools and procedures required to implement the modeling scheme developed in Task 1. These tools will be integrated with the appropriate models and tested to ensure that the entire system works as visualized.

Task 5—Standardized Modeling Outputs

This task is to develop a process that will create a standardized set of outputs from any given model run for use in the analysis process. These outputs will be defined through close coordination with the other work groups and/or study plans that are using the information in their analysis (Attachment C).

The subtasks involved include:

- Define standard modeling outputs for analysis. These may include desired tables, graphics, statistical analysis as well as raw data for use in other modeling and/or analysis efforts. This will require coordination with the work groups that expect modeling results for use in their analysis to ensure that the appropriate outputs are produced.

- Define model output requirements to produce the outputs.
- Ensure that appropriate data from model outputs is in central database.
- Develop procedure to produce the standardized set of outputs.
- Complete documentation of each of the standardized modeling outputs including source of data, accuracy of data, appropriate usage of data, etc.

Task 6—Other Modeling Outputs

This task includes the development of other model outputs that may be required for special purposes. These could include one-time requests for modeling output in various formats. If the outputs are expected to be requested for most or all modeling simulations then they will be included in the Standardized Modeling Outputs under Task 5.

6.0 Results and Products/Deliverables

Results

The result of this study will be a comprehensive suite of modeling tools available to answer or study the multitude of issues associated with the relicensing effort. The exact form and content of this suite will remain flexible throughout the duration of the relicensing process to allow reaction to different requirements that may happen over time.

Products/Deliverables

Models

This deliverable will include the individual models developed under this study plan. These are:

- Statewide Operations Model (CALSIM II)
- Oroville-Thermalito Complex Local Operations Model
- Oroville Reservoir Temperature Model
- Thermalito Forebay-Afterbay Temperature Model (Empirical Model)
- Feather River Temperature Model
- Feather River Flow – Stage Model
- Watershed Model (if required)
- Flood Control Model (if required)

Modeling Environment

This will include all instructions, procedures, utilities, tools, and databases other than the individual models themselves, required to perform a complete simulation of any given alternative and to produce the standardized output products.

Standardized Output Products

This will be a standardized set of output products from the modeling that are generated from each alternative simulated. The products will include tables, graphics, statistical analysis, and raw data from model output as appropriate. These products will be given to other work groups for use in their analysis.

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

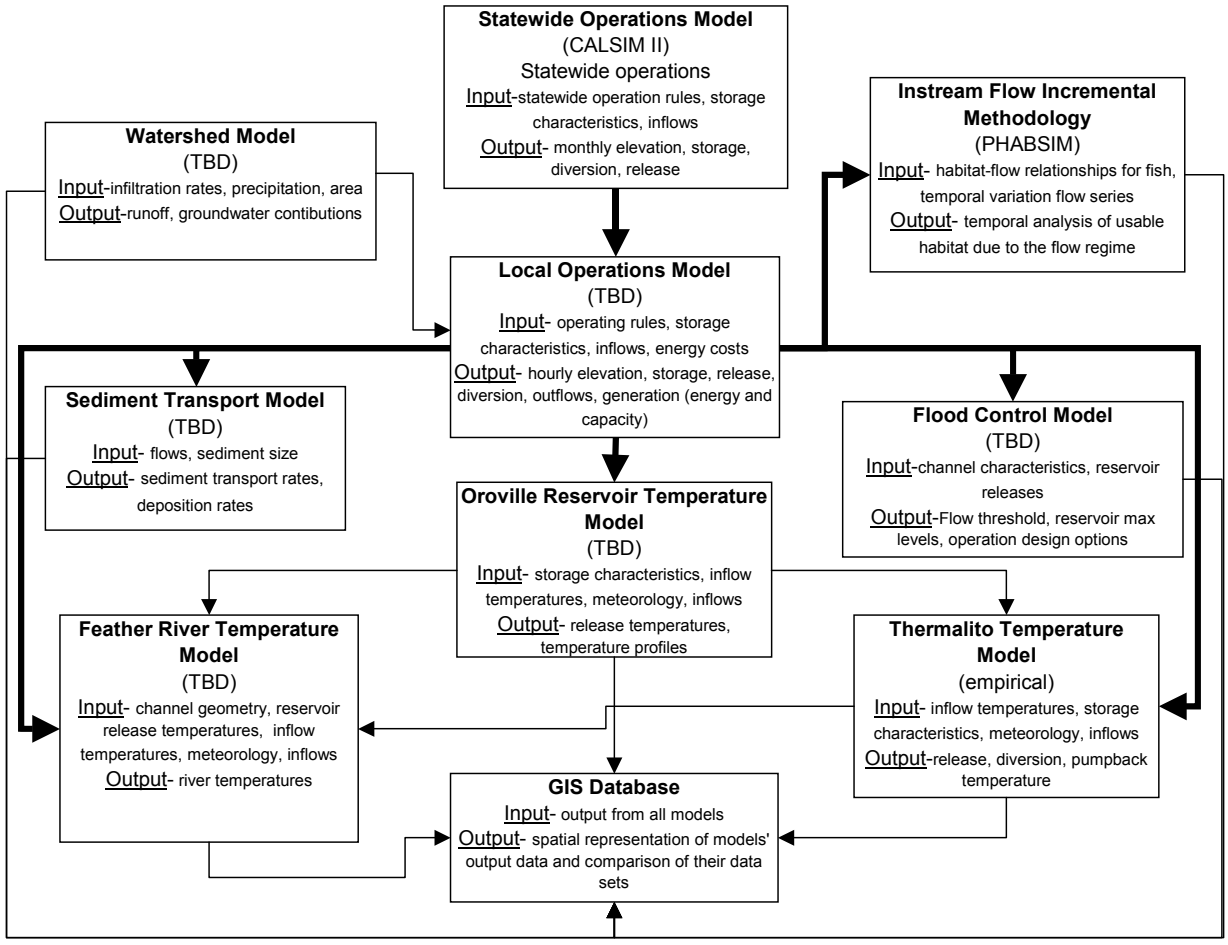
This study will require coordination with all model development study plans as they are all designed to produce a model to be used in the final modeling scheme. The study will also require coordination with all study plans that require output from the modeling to define the content and format of the output they want.

8.0 Schedule

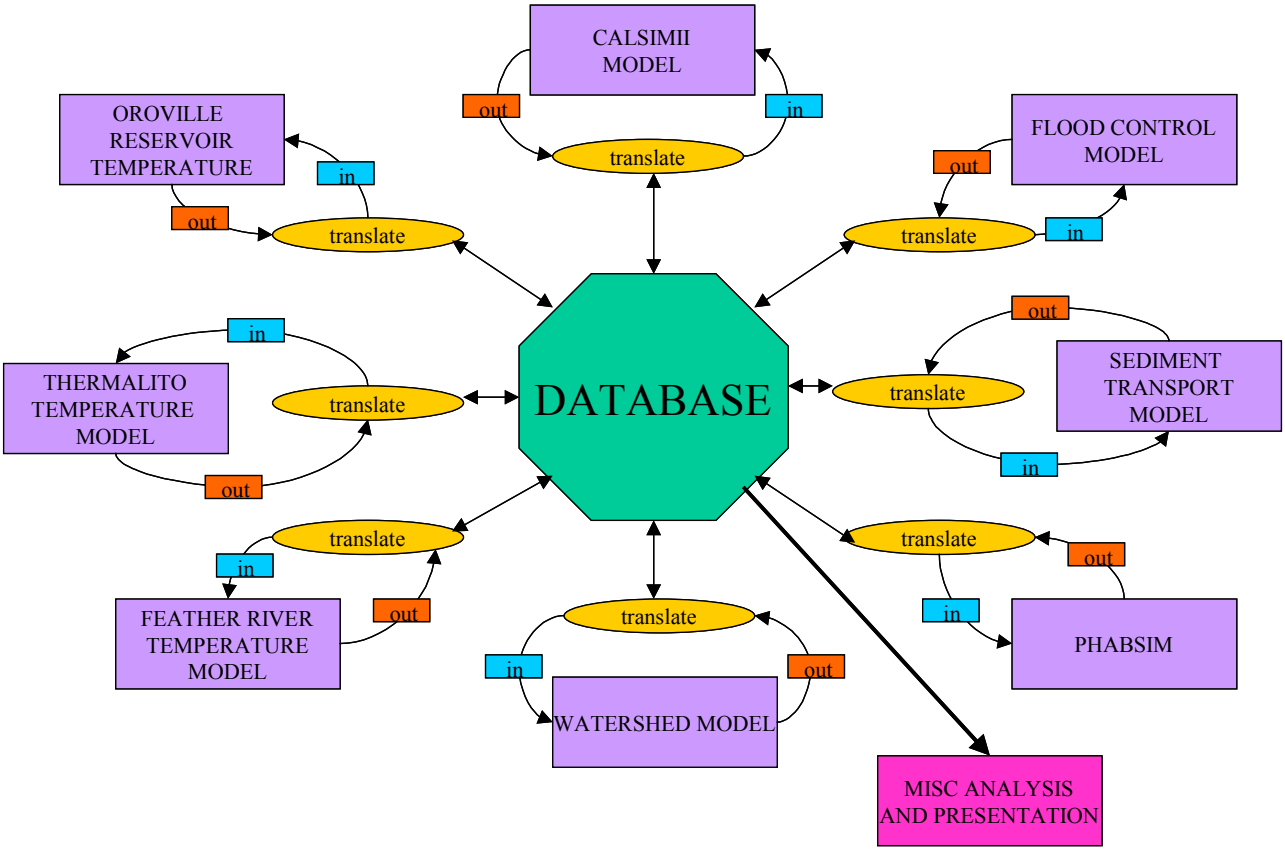
This section under development.

Attachment A
Modeling Flow Chart

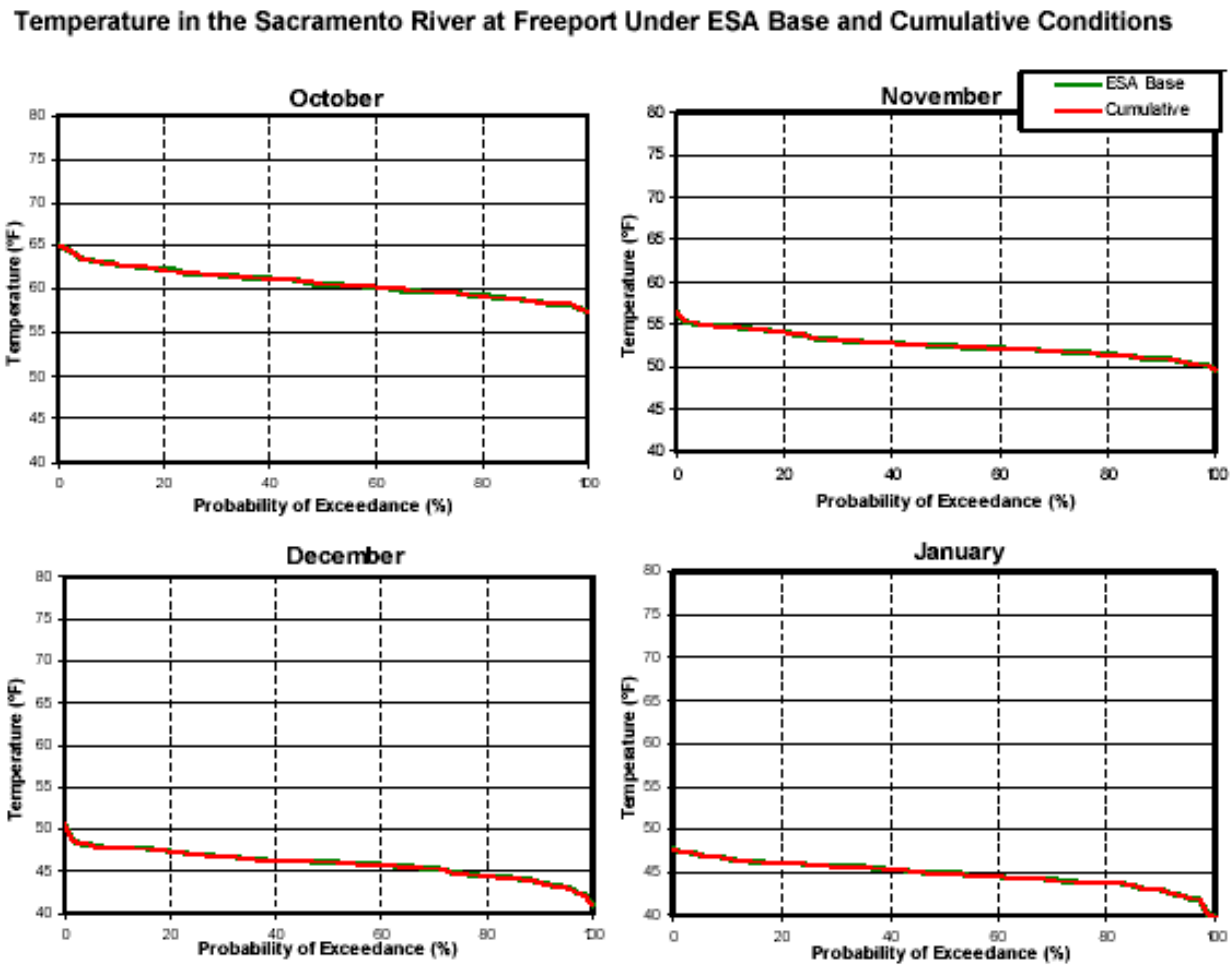
Modeling Studies Flow Chart

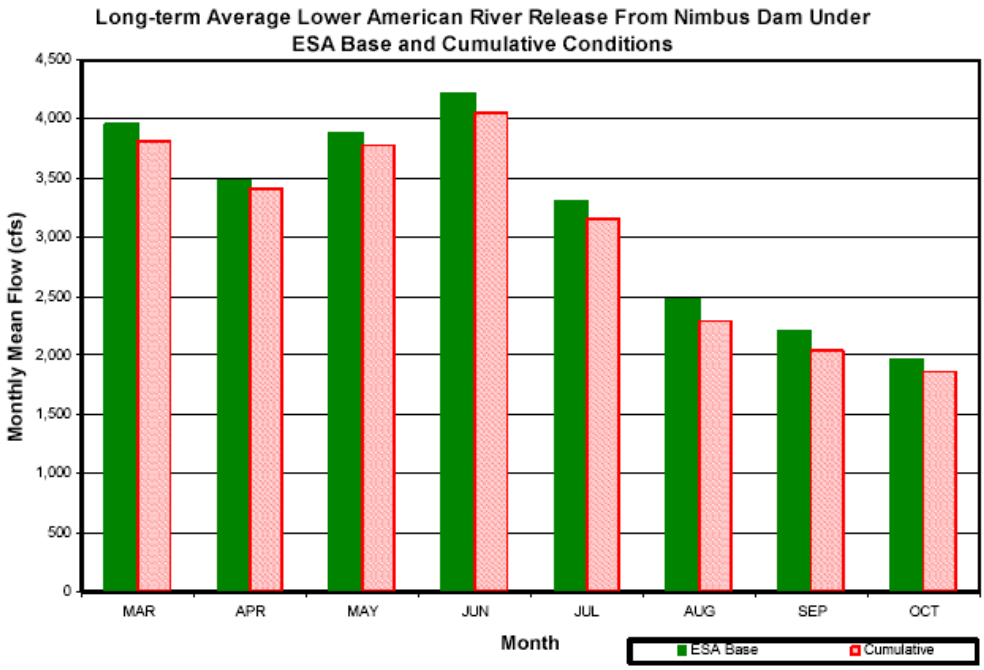


Attachment B
Modeling Data Management Scheme



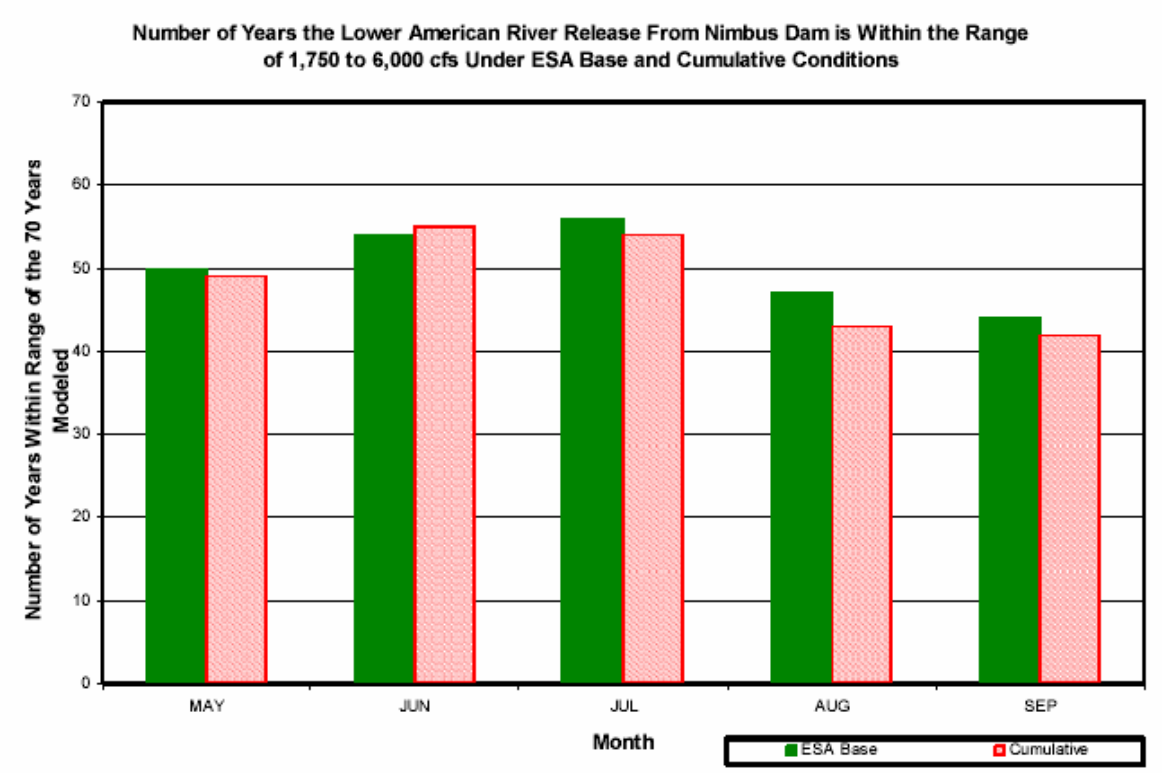
Attachment C
Examples of Standard Outputs

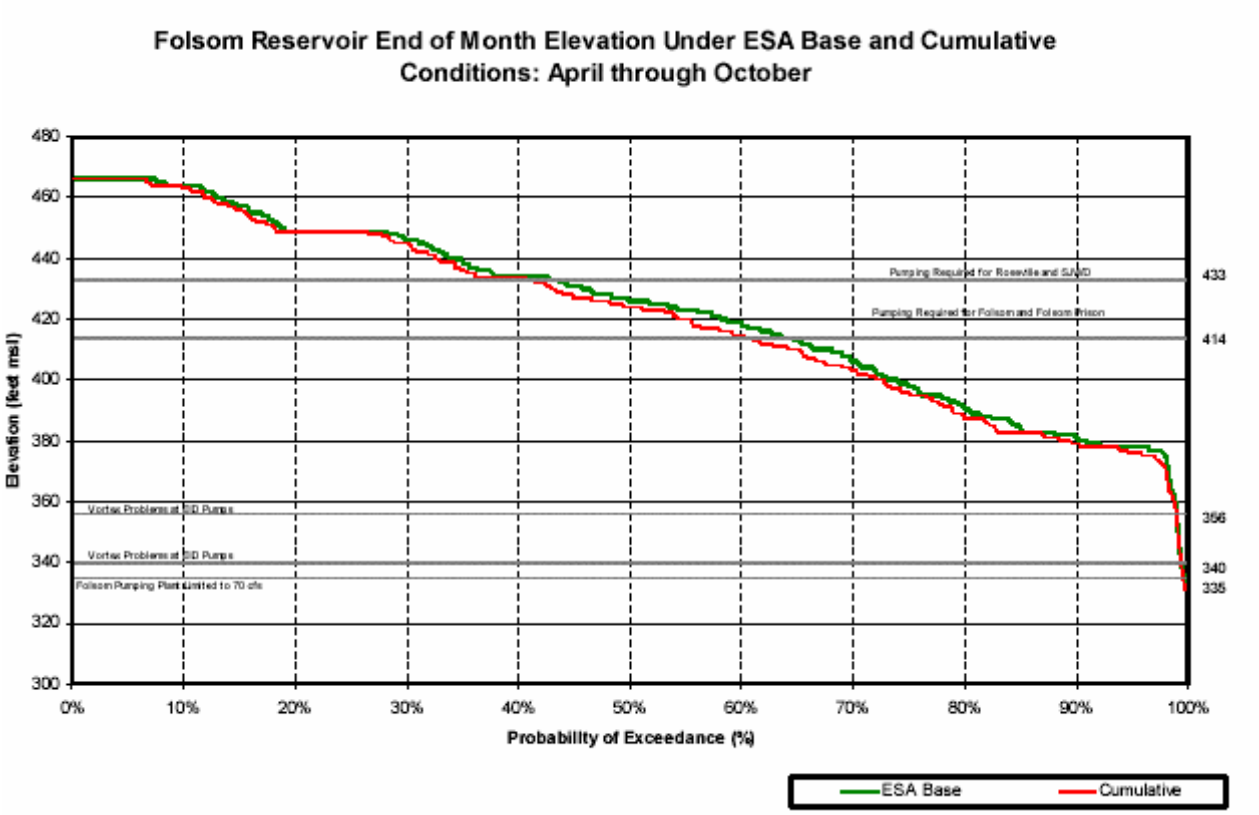




Flow Ranges Affecting Riparian Vegetation in the Lower American River Below Nimbus Dam Under ESA Base and Cumulative Conditions									
Month	Number of Years[1] Within Specified Ranges								
	3,000-4,500 cfs			< 1,765 cfs			< 2,000 cfs		
	ESA Base	Cumulative	Difference	ESA Base	Cumulative	Difference	ESA Base	Cumulative	Difference
Mar	21	20	-1	12	15	3	14	16	2
Apr	17	17	0	11	12	1	11	12	1
May	29	29	0	11	12	1	11	12	1
Jun	27	28	1	7	7	0	8	9	1
Jul	11	10	-1	13	15	2	17	16	-1
Aug	25	23	-2	25	28	3	28	32	4
Sep	16	15	-1	29	34	5	32	38	6
Oct	3	2	-1	28	31	3	28	31	3

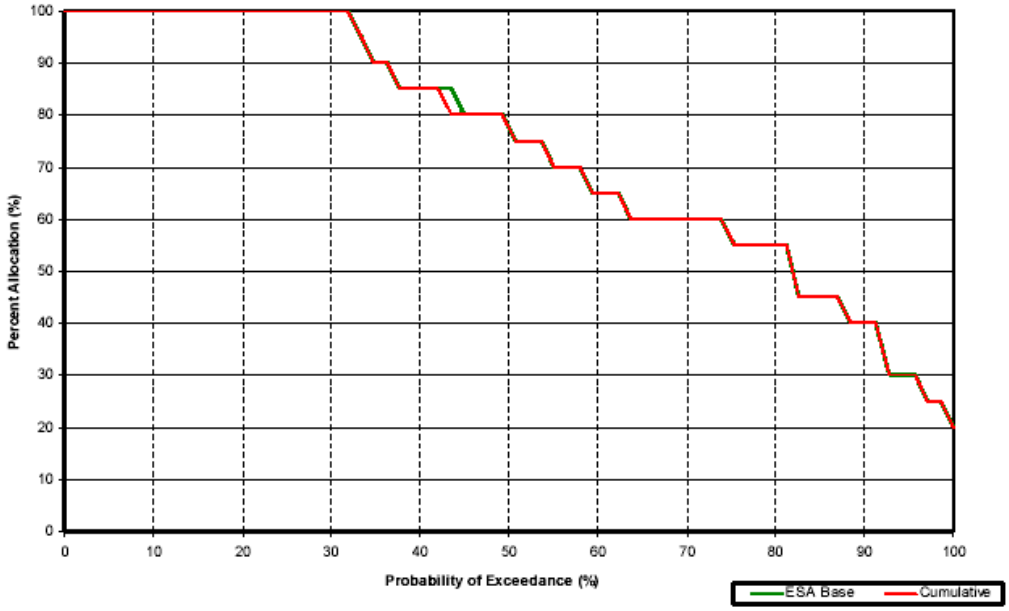
[1] Based on 70 years modeled.


Number of Years the Lower American River Release From Nimbus Dam is Within the Range of 1,750 to 6,000 cfs Under ESA Base and Cumulative Conditions
Number of Years Within Range of the 70 Years Modeled
70
60
50
40
30
20
10
0
MAY
JUN
JUL
AUG
SEP
Month
ESA Base
Cumulative


Folsom Reservoir End of Month Elevation Under ESA Base and Cumulative Conditions: April through October
Elevation (feet msl)
480
460
440
420
400
380
360
340
320
300
Pumping Required for Roseville and SJWD
Pumping Required for Folsom and Folsom Prison
Vortex Problems at SID Pumps
Vortex Problems at SID Pumps
Folsom Pumping Plant Limited to 70 cfs
433
414
356
340
335
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Probability of Exceedance (%)
ESA Base
Cumulative

Long-term Average Shasta Reservoir End of Month Elevation Under ESA Base and Cumulative Conditions			
Month	Average Elevation[1] (feet msl)		
	ESA Base	Cumulative	Difference
Mar	1026	1025	-1
Apr	1037	1036	-1
May	1038	1037	-1
Jun	1027	1026	-1
Jul	1007	1006	-1
Aug	987	986	-1
Sep	980	979	-1
[1] Based on 70 years modeled.			

Percent Allocation to SWP Contractors Under ESA Base and Cumulative Conditions



Percent Allocation to SWP Contractors Under ESA Base and Cumulative Conditions[1]			
	ESA Base	Cumulative	Difference
Average	74%	74%	0%
Minimum	20%	20%	0%
Maximum	100%	100%	0%
Median	78%	78%	0%
[1] Based on the 70 years modeled.			